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EXAMINER	
KIM, CHONG R	
ART UNIT	PAPER NUMBER
2623	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/819,449	PETROV ET AL	
	Examiner	Art Unit	
	Charles Kim	2623	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 23 August 2004.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-32 is/are pending in the application.

4a) Of the above claim(s) 11-15 and 27-31 is/are withdrawn from consideration.

5)☒ Claim(s) 8 and 24 is/are allowed.

6)☒ Claim(s) 1-4,7,9,10,16-20,23,25,26 and 32 is/are rejected.

7)☒ Claim(s) 5,6,21 and 22 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 13 August 2001 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 2/12/02.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Response to Restriction Requirement

1. Applicant's election without traverse of group I (claims 1-10, 16-26, 32) in the reply filed on August 23, 2004 is acknowledged. Accordingly, claims 11-15, 27-31 are withdrawn from further consideration.

Claim Objections

The following quotation of 37 CFR § 1.75(a) and is the basis of objection:

> (a) The specification must conclude with a claim particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention or discovery.

2. Claims 1-6, 10, 16, 17, 21, 22, 32 are objected to under 37 CFR § 1.75 (a) as failing to particularly point out and distinctly claim the subject matter which the applicant regards as his invention or discovery.

Referring to claim 1, the phrase "describe <u>the a</u> silhouette contour" in lines 12-13 is grammatically incorrect. It appears that the applicant intended the phrase to read "describe a silhouette contour". A similar rejection is applicable to claim 10. Appropriate corrections are required.

Referring to claim 1, the phrase "so that it bounds <u>an</u> the space which falls <u>with</u> the boundaries of the silhouette contour" in lines 31-32 is grammatically incorrect. It appears that the applicant intended the phrase to read "so that it bounds the space which falls within the

boundaries of the silhouette contour". A similar objection is applicable to claims 2-4, 17. Appropriate corrections are required.

Referring to claim 5, the phrase "a reference the three-dimensional point" in line 28 is grammatically incorrect. It appears that the applicant intended the phrase to read "a reference <u>to</u> the three-dimensional point". A similar objection is applicable to claim 21. Appropriate correction is required.

Referring to claim 6, there appears to be a typographical error in the phrase "at least on of the silhouette contour polygons" in line 24. It appears that the applicant intended the phrase to read "at least one of the silhouette contour polygons." A similar objection is applicable to claim 22. Appropriate correction is required.

Referring to claim 16, the phrase "processing the first plurality of image locate within" in line 11 is grammatically incorrect. It appears that the applicant intended the phrase to read "processing the first plurality of image <u>to</u> locate within." A similar objection is applicable to claim 32. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 4, 7, 9, 16, 20, 23, 32 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Referring to claim 4, the phrase "one of the two-dimensional contours" in lines 15-16 renders the claim indefinite because it is unclear which "contour" (contour or silhouette contour polygon) is being claimed. For examination purposes, the phrase "contours" will be interpreted as the silhouette contour polygons. A similar rejection is applicable to claims 9 and 20. Appropriate corrections are required.

Referring to claim 7, the phrase "the second point of intersection" in lines 26-27 lacks antecedent basis. A similar rejection is applicable to claim 23. Appropriate correction is required.

Referring to claim 16, the phrase "of each image" in line 18 renders the claim indefinite because it is unclear which "image" (first plurality or second plurality of images) is being claimed. For examination purposes, the phrase "image" in line 18 will be interpreted as an image from the second plurality of images. A similar rejection is applicable to claim 32. Appropriate correction is required.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-4, 9-10, 17-20, 25-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Matsumoto et al., U.S. Patent No. 6,356,272 ("Matsumoto"), Nishida,

U.S. Patent No. 6,424,746 ("Nishida"), and Watanabe et al., U.S. Patent Application Publication No. 2001/0005424 ("Watanabe").

Referring to claim 1, Matsumoto discloses a method for constructing a 3D model of an object comprising the steps of:

a. capturing a series of photographic images of an object using a camera having a planar image collector, where the step of capturing images collects the images of the object from a plurality of different angles, where the angle associated with each image is determined from a pre-selected reference point in three-dimensional space and where from that associated angle it is possible to determine the location in three-dimensional space of the plane of the image collection (col. 15, lines 25-67, col. 16, line 65-col. 17, line 3 and figures 1 and 6);

b. processing each photographic image to identify clusters of pixels in the image that describe the object (col. 17, lines 2-27 and figure 6);

c. tracing the perimeter of each cluster of the pixels in the image that describe the object to gather a set of pixels which describe a silhouette contour of the object's shape, and thereby create a set of silhouette contours (col. 17, lines 2-27 and figure 6).

Matsumoto does not explicitly disclose the step of processing the points of the silhouette contours to select from those points the vertices of a polygon which approximates the silhouette contour of the object's shape, and thereby create a set of silhouette contour polygons. However, this feature was exceedingly well known in the art. For example, Nishida discloses the step of processing points of a silhouette contour to select from those points the vertices of a polygon which approximates the silhouette contour of an object's shape (col. 18, lines 19-41 and figures 8-10).

Matsumoto and Nishida are combinable because they are both concerned with image processing methods for determining a contour image of an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the silhouette contours of Matsumoto so that a polygon which approximates the silhouette contour of the object's shape is created, as taught by Nishida. The suggestion/motivation for doing so would have been to provide a compact expression of the structural features of the contour of the object, thereby enhancing the efficiency of the image processing method. Therefore, it would have been obvious to combine Matsumoto with Nishida.

Matsumoto further discloses the step of creating an initial three-dimensional model of the object using one of the silhouette contours, the three-dimensional model being formed by making a conical projection from one of the set of silhouette contours, creating along the bounds of the conical projection a near and far face for the object model, with the near and far faces each representing a projection of the vertices of the silhouette contour in three-dimensional space (col. 17, line 29-col. 18, line 10 and figures 7-8). In view of the combination described above, Matsumoto and Nishida disclose an initial three-dimensional model of the object that is based on the projection of one of the silhouette contour polygons.

Matsumoto and Nishida do not explicitly disclose the step of creating additional faces to span volume between the points of the near and far faces based on pairs of adjacent vertices in the near and far faces. However, Official notice is taken that the step of creating additional faces to span volume between the points of two faces based on pairs of adjacent vertices in the two faces was exceedingly well known in the art. Therefore, it would have been obvious to modify the method of Matsumoto and Nishida so that additional faces are created to span volume

between the points of the near and far faces based on pairs of adjacent vertices in the near and far faces. The suggestion/motivation for doing so would have been to enhance the appearance of the initial three-dimensional model.

Matsumoto further discloses the step of refining the initial three-dimensional model (col. 18, lines 3-47 and figure 9), but does not explicitly disclose that the refining process includes the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane of image collection for given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour polygons for the given image. However, the steps recited in the claimed refining process is not considered to be patently distinct from Matsumoto's refining process because both refining processes appear to be functionally equivalent. For example, Matsumoto explains that the initial three-dimensional model is refined by a (second) projection of a selected silhouette onto the initial model, wherein any portions of model that do not intersect the volume formed by the second projection are removed (col. 18, lines 10-26 and figure 9). Note that the steps described above in Matsumoto's refining process are functionally equivalent to the steps of projecting the initial three-dimensional model onto the two-dimensional plane for the selected silhouette, and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour for the given image--both refining processes result in the removal of any portions of the initial three-dimensional model that do not intersect the volume formed by the second projection of the selected silhouette onto the model. The applicant's specification provides further evidence of the functional equivalence described above. For example, on page 62, the applicants state:

> "To refine the initial, (rough) 317 model depicted at 690 based on the second silhouette contour polygon 694, the system and method of the present invention uses a procedure (described in further detail below) that in effect projects the initial (rough) 3D model depicted at 690 through a conical projection of the second silhouette 694. The system then adjusts the initial, (rough) 317 model depicted at 690, clipping from the model those areas that do not intersect the volume formed by the second projection."

Matsumoto clearly discloses these steps for his refining process (col. 18, lines 3-47 and figure 9). Accordingly, it appears that the results of Matsumoto's refining process are equivalent to the results of the claimed refining process, and therefore, the two refining processes are not considered patently distinct.

Despite the functional equivalence between the two refining processes, the Examiner notes that Matsumoto and Nishida still do not explicitly disclose the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane of image collection for a given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour polygons for the given image. However, these features were exceedingly well known in the art. For example, Watanabe discloses a three-dimensional model refining process that includes the steps of projecting each face of an initial three-dimensional model of an object onto a two-dimensional plane of image collection for a given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour for the given image (page 4, paragraphs 43, 53 and page 5, paragraph 58).

Matsumoto, Nishida, and Watanabe are combinable because they are all concerned with image processing methods for modeling an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the refining process of Matsumoto and Nishida so that it includes the steps taught by Watanabe. The suggestion/motivation for doing so would have been to enhance the precision of the three-dimensional model (Watanabe page 1, paragraphs 7-10). Therefore, it would have been obvious to combine Matsumoto and Nishida with Watanabe to obtain the invention as specified in claim 1.

Referring to claim 2, Matsumoto discloses a method for constructing a 3D model of an object from a series of photographic images of the object, where the series of photographic images have been captured from a plurality of different angles, where the angle associated with each image is determined from a pre-selected reference point in three-dimensional space and where the image is comprised of a plurality of pixels (col. 15, lines 25-67, col. 16, line 65-col. 17, line 3 and figures 1 and 6), the method comprising the steps of:

a. processing each photographic image to identify clusters of pixels in the image that describe the object (col. 17, lines 2-27 and figure 6);

b. tracing the perimeter of each cluster of the pixels in the image that describe the object to gather a set of pixels which describe the a silhouette contour of the object's shape, and thereby create a set of silhouette contours (col. 17, lines 2-27 and figure 6).

Matsumoto does not explicitly disclose the step of processing the points of the silhouette contours to select from those points the vertices of a polygon which approximates the silhouette contour of the object's shape, and thereby create a set of silhouette contour polygons. However, this feature was exceedingly well known in the art. For example, Nishida discloses the step of

processing points of a silhouette contour to select from those points the vertices of a polygon which approximates the silhouette contour of an object's shape (col. 18, lines 19-41 and figures 8-10).

Matsumoto and Nishida are combinable because they are both concerned with image processing methods for determining a contour image of an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the silhouette contours of Matsumoto so that a polygon which approximates the silhouette contour of the object's shape is created, as taught by Nishida. The suggestion/motivation for doing so would have been to provide a compact expression of the structural features of the contour of the object, thereby enhancing the efficiency of the image processing method. Therefore, it would have been obvious to combine Matsumoto with Nishida.

Matsumoto further discloses the step of creating an initial three-dimensional model of the object using one of the silhouette contours, the three-dimensional model being formed by making a conical projection from one of the set of silhouette contours, creating along the bounds of the conical projection a near and far face for the object model, with the near and far faces each representing a projection of the vertices of the silhouette contour in three-dimensional space (col. 17, line 29-col. 18, line 10 and figures 7-8). In view of the combination described above, Matsumoto and Nishida disclose an initial three-dimensional model of the object that is based on the projection of one of the silhouette contour polygons. Accordingly, the initial three-dimensional model of the object comprises a plurality of polygonal faces.

Matsumoto further discloses the step of refining the initial three-dimensional model (col. 18, lines 3-47 and figure 9), but does not explicitly disclose that the refining process includes the

steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane of image collection for given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour polygons for the given image. However, the claimed refining process is not considered to be patently distinct from Matsumoto's refining process because both refining processes appear to be functionally equivalent. For example, Matsumoto explains that the initial three-dimensional model is refined by a (second) projection of a selected silhouette onto the initial model, wherein any portions of model that do not intersect the volume formed by the second projection are removed (col. 18, lines 10-26 and figure 9). Note that the steps described above in Matsumoto's refining process are functionally equivalent to the steps of projecting the initial three-dimensional model onto the two-dimensional plane for the selected silhouette, and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour for the given image--both refining processes result in the removal of any portions of the initial three-dimensional model that do not intersect the volume formed by the second projection of the selected silhouette onto the model. The applicant's specification provides further evidence of the functional equivalence described above. For example, on page 62, the applicants state:

> "To refine the initial, (rough) 317 model depicted at 690 based on the second silhouette contour polygon 694, the system and method of the present invention uses a procedure (described in further detail below) that in effect projects the initial (rough) 3D model depicted at 690 through a conical projection of the second silhouette 694. The system then adjusts the initial, (rough) 317 model

depicted at 690, clipping from the model those areas that do not intersect the volume formed by the second projection."

Matsumoto clearly discloses these steps for his refining process (col. 18, lines 3-47 and figure 9). Accordingly, it appears that the results of Matsumoto's refining process are equivalent to the results of the claimed refining process, and therefore, the two refining processes are not considered patently distinct.

Despite the functional equivalence between the two refining processes, the Examiner notes that Matsumoto and Nishida still do not explicitly disclose the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane of image collection for a given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour polygons for the given image. However, these features were exceedingly well known in the art. For example, Watanabe discloses a three-dimensional model refining process that includes the steps of projecting each face of an initial three-dimensional model of an object onto a two-dimensional plane of image collection for a given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour for the given image (page 4, paragraphs 43, 53 and page 5, paragraph 58).

Matsumoto, Nishida, and Watanabe are combinable because they are all concerned with image processing methods for modeling an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the refining process of Matsumoto and Nishida so that it includes the steps taught by Watanabe. The suggestion/motivation for doing so would have been to enhance the precision of the three-dimensional model (Watanabe

page 1, paragraphs 7-10). Therefore, it would have been obvious to combine Matsumoto and Nishida with Watanabe to obtain the invention as specified in claim 2.

Referring to claim 3, Matsumoto discloses a method for constructing a 3D model of an object from a series of photographic images of the object, where the series of photographic images have been captured from a plurality of different angles about the object, where the angle associated with each image is determined from a pre-selected reference point in three-dimensional space and where the image is comprised of a plurality of pixels (col. 15, lines 25-67, col. 16, line 65-col. 17, line 3 and figures 1 and 6), the method comprising the step of:

a. processing each photographic image to identify those clusters of pixels in the image that describe the object (col. 17, lines 2-27 and figure 6).

Matsumoto does not explicitly disclose the step of processing those clusters of pixels which describe the object and select from those points the vertices of a polygon which approximates a silhouette contour describing the object's shape, and thereby creating a set of silhouette contour polygons. However, this feature was exceedingly well known in the art. For example, Nishida discloses the step of processing clusters of pixels which describe an object and select from those points the vertices of a polygon which approximates a silhouette contour describing the object's shape (col. 18, lines 19-41 and figures 8-10).

Matsumoto and Nishida are combinable because they are both concerned with image processing methods for determining a contour image of an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the method of Matsumoto so that a polygon which approximates a silhouette contour of the object's shape is created based on the clusters of pixels that describe the object, as taught by Nishida. The

suggestion/motivation for doing so would have been to provide a compact expression of the structural features of the contour of the object, thereby enhancing the efficiency of the image processing method. Therefore, it would have been obvious to combine Matsumoto with Nishida.

Matsumoto further discloses the step of creating an initial three-dimensional model of the object using one of the silhouette contours, the three-dimensional model being formed by making a conical projection from one of the set of silhouette contours, creating along the bounds of the conical projection a near and far face for the object model, with the near and far faces each representing a projection of the vertices of the silhouette contour in three-dimensional space (col. 17, line 29-col. 18, line 10 and figures 7-8). In view of the combination described above, Matsumoto and Nishida disclose an initial three-dimensional model of the object that is based on the projection of one of the silhouette contour polygons. Accordingly, the initial three-dimensional model of the object comprises a plurality of polygonal faces.

Matsumoto further discloses the step of refining the initial three-dimensional model (col. 18, lines 3-47 and figure 9), but does not explicitly disclose that the refining process includes the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane of image collection for given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour polygons for the given image. However, the claimed refining process is not considered to be patently distinct from Matsumoto's refining process because both refining processes appear to be functionally equivalent. For example, Matsumoto explains that the initial three-dimensional model is refined by a (second) projection of a selected silhouette onto the initial model, wherein any portions of model that do not intersect the volume formed by the second

projection are removed (col. 18, lines 10-26 and figure 9). Note that the steps described above in Matsumoto's refining process are functionally equivalent to the steps of projecting the initial three-dimensional model onto the two-dimensional plane for the selected silhouette, and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour for the given image--both refining processes result in the removal of any portions of the initial three-dimensional model that do not intersect the volume formed by the second projection of the selected silhouette onto the model. The applicant's specification provides further evidence of the functional equivalence described above. For example, on page 62, the applicants state:

> "To refine the initial, (rough) 317 model depicted at 690 based on the second silhouette contour polygon 694, the system and method of the present invention uses a procedure (described in further detail below) that in effect projects the initial (rough) 3D model depicted at 690 through a conical projection of the second silhouette 694. The system then adjusts the initial, (rough) 317 model depicted at 690, clipping from the model those areas that do not intersect the volume formed by the second projection."

Matsumoto clearly discloses these steps for his refining process (col. 18, lines 3-47 and figure 9). Accordingly, it appears that the results of Matsumoto's refining process are equivalent to the results of the claimed refining process, and therefore, the two refining processes are not considered patently distinct.

Despite the functional equivalence between the two refining processes, the Examiner notes that Matsumoto and Nishida still do not explicitly disclose the steps of projecting each face

of the initial three-dimensional model of the object onto the two-dimensional plane of image collection for a given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour polygons for the given image. However, these features were exceedingly well known in the art. For example, Watanabe discloses a three-dimensional model refining process that includes the steps of projecting each face of an initial three-dimensional model of an object onto a two-dimensional plane of image collection for a given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour for the given image (page 4, paragraphs 43, 53 and page 5, paragraph 58).

Matsumoto, Nishida, and Watanabe are combinable because they are all concerned with image processing methods for modeling an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the refining process of Matsumoto and Nishida so that it includes the steps taught by Watanabe. The suggestion/motivation for doing so would have been to enhance the precision of the three-dimensional model (Watanabe page 1, paragraphs 7-10). Therefore, it would have been obvious to combine Matsumoto and Nishida with Watanabe to obtain the invention as specified in claim 3.

Referring to claim 4 as best understood, Matsumoto discloses a method for constructing a 3D model of an object from a plurality of two-dimensional contours comprised of pixels that describe the boundaries of the object, with each of the plurality of two-dimensional contours representing a view of the object from a different angle, where the angle associated with each contour being determined from a pre-selected reference point in three-dimensional space (col.

15, lines 25-67, col. 16, line 65-col. 17, line 3 and figures 1 and 6), the method comprising the step of processing the plurality of contours which describe the object.

Matsumoto does not explicitly disclose the step of selecting from the points of each contour the vertices of a polygon which approximates a contour describing the object's shape, and thereby creating a set of silhouette contour polygons. However, this feature was exceedingly well known in the art. For example, Nishida discloses the step of processing points of a contour which describe an object to select from those points the vertices of a polygon which approximates the silhouette contour of the object's shape (col. 18, lines 19-41 and figures 8-10).

Matsumoto and Nishida are combinable because they are both concerned with image processing methods for determining a contour image of an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the contours of Matsumoto so that a polygon which approximates the silhouette contour of the object's shape is created, as taught by Nishida. The suggestion/motivation for doing so would have been to provide a compact expression of the structural features of the contour of the object, thereby enhancing the efficiency of the image processing method. Therefore, it would have been obvious to combine Matsumoto with Nishida.

Matsumoto further discloses the step of creating an initial three-dimensional model of the object using one of the silhouette contours, the three-dimensional model being formed by making a conical projection from one of the set of silhouette contours, creating along the bounds of the conical projection a near and far face for the object model, with the near and far faces each representing a projection of the vertices of the silhouette contour in three-dimensional space (col. 17, line 29-col. 18, line 10 and figures 7-8). In view of the combination described above,

Matsumoto and Nishida disclose an initial three-dimensional model of the object that is based on the projection of one of the silhouette contour polygons. Accordingly, the initial three-dimensional model of the object comprises a plurality of polygonal faces.

Matsumoto further discloses the step of refining the initial three-dimensional model (col. 18, lines 3-47 and figure 9), but does not explicitly disclose that the refining process includes the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane which also contains a projection of one of the two-dimensional contour polygons and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the projected silhouette contour. However, the claimed refining process is not considered to be patently distinct from Matsumoto's refining process because both refining processes appear to be functionally equivalent. For example, Matsumoto explains that the initial three-dimensional model is refined by a (second) projection of a selected silhouette onto the initial model, wherein any portions of model that do not intersect the volume formed by the second projection are removed (col. 18, lines 10-26 and figure 9). Note that the steps described above in Matsumoto's refining process are functionally equivalent to the steps of projecting the initial three-dimensional model onto the two-dimensional plane which also contains a projection of one of the two-dimensional silhouette contour polygons and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the projected silhouette contour --both refining processes result in the removal of any portions of the initial three-dimensional model that do not intersect the volume formed by the second projection of the selected silhouette onto the model. The applicant's specification provides

further evidence of the functional equivalence described above. For example, on page 62, the applicants state:

> "To refine the initial, (rough) 317 model depicted at 690 based on the second silhouette contour polygon 694, the system and method of the present invention uses a procedure (described in further detail below) that in effect projects the initial (rough) 3D model depicted at 690 through a conical projection of the second silhouette 694. The system then adjusts the initial, (rough) 317 model depicted at 690, clipping from the model those areas that do not intersect the volume formed by the second projection."

Matsumoto clearly discloses these steps for his refining process (col. 18, lines 3-47 and figure 9). Accordingly, it appears that the results of Matsumoto's refining process are equivalent to the results of the claimed refining process, and therefore, the two refining processes are not considered patently distinct.

Despite the functional equivalence between the two refining processes, the Examiner notes that Matsumoto and Nishida still do not explicitly disclose the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane which also contains a projection of one of the two-dimensional contour polygons and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the projected silhouette contour. However, these features were exceedingly well known in the art. For example, Watanabe discloses a three-dimensional model refining process that includes the steps of projecting each face of an initial three-dimensional model of an object onto a two-dimensional plane which also contains a projection of one of a two-dimensional contour and

revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the projected silhouette contour (page 4, paragraphs 43, 53 and page 5, paragraph 58).

Matsumoto, Nishida, and Watanabe are combinable because they are all concerned with image processing methods for modeling an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the refining process of Matsumoto and Nishida so that it includes the steps taught by Watanabe. The suggestion/motivation for doing so would have been to enhance the precision of the three-dimensional model (Watanabe page 1, paragraphs 7-10). Therefore, it would have been obvious to combine Matsumoto and Nishida with Watanabe to obtain the invention as specified in claim 4.

Referring to claim 9 as best understood, Matsumoto discloses a method for constructing a 3D model of an object from a plurality of two-dimensional contours comprised of pixels that describe the boundaries of the object, with each of the plurality of two-dimensional contours representing a view of the object from a different angle, where the angle associated with each contour being determined from a pre-selected reference point in three-dimensional space (col. 15, lines 25-67, col. 16, line 65-col. 17, line 3 and figures 1 and 6), the method comprising the step of processing the plurality of contours which describe the object.

Matsumoto does not explicitly disclose the step of selecting from the points of each contour the vertices of a polygon which approximates a contour describing the object's shape, and thereby creating a set of silhouette contour polygons. However, this feature was exceedingly well known in the art. For example, Nishida discloses the step of processing points of a contour

which describe an object to select from those points the vertices of a polygon which approximates the silhouette contour of the object's shape (col. 18, lines 19-41 and figures 8-10).

Matsumoto and Nishida are combinable because they are both concerned with image processing methods for determining a contour image of an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the contours of Matsumoto so that a polygon which approximates the silhouette contour of the object's shape is created, as taught by Nishida. The suggestion/motivation for doing so would have been to provide a compact expression of the structural features of the contour of the object, thereby enhancing the efficiency of the image processing method. Therefore, it would have been obvious to combine Matsumoto with Nishida.

Matsumoto further discloses the step of creating an initial three-dimensional model of the object using one of the silhouette contours, the three-dimensional model being formed by making a conical projection from one of the set of silhouette contours, creating along the bounds of the conical projection a near and far face for the object model, with the near and far faces each representing a projection of the vertices of the silhouette contour in three-dimensional space (col. 17, line 29-col. 18, line 10 and figures 7-8). In view of the combination described above, Matsumoto and Nishida disclose an initial three-dimensional model of the object that is based on the projection of one of the silhouette contour polygons. Accordingly, the initial three-dimensional model of the object comprises a plurality of polygonal faces.

Matsumoto further discloses the step of refining the initial three-dimensional model (col. 18, lines 3-47 and figure 9) and creating a triangulated mesh model from the refined three-dimensional model of the object (figure 6D), but does not explicitly disclose that the refining

process includes the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane which also contains a projection of one of the two-dimensional contour polygons and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the projected silhouette contour. However, the claimed refining process is not considered to be patently distinct from Matsumoto's refining process because both refining processes appear to be functionally equivalent. For example, Matsumoto explains that the initial three-dimensional model is refined by a (second) projection of a selected silhouette onto the initial model, wherein any portions of model that do not intersect the volume formed by the second projection are removed (col. 18, lines 10-26 and figure 9). Note that the steps described above in Matsumoto's refining process are functionally equivalent to the steps of projecting the initial three-dimensional model onto the two-dimensional plane which also contains a projection of one of the two-dimensional silhouette contour polygons and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the projected silhouette contour --both refining processes result in the removal of any portions of the initial three-dimensional model that do not intersect the volume formed by the second projection of the selected silhouette onto the model. The applicant's specification provides further evidence of the functional equivalence described above. For example, on page 62, the applicants state:

> "To refine the initial, (rough) 317 model depicted at 690 based on the second silhouette contour polygon 694, the system and method of the present invention uses a procedure (described in further detail below) that in effect projects the initial (rough) 3D model depicted at 690 through a conical projection of the

second silhouette 694. The system then adjusts the initial, (rough) 317 model depicted at 690, clipping from the model those areas that do not intersect the volume formed by the second projection."

Matsumoto clearly discloses these steps for his refining process (col. 18, lines 3-47 and figure 9). Accordingly, it appears that the results of Matsumoto's refining process are equivalent to the results of the claimed refining process, and therefore, the two refining processes are not considered patently distinct.

Despite the functional equivalence between the two refining processes, the Examiner notes that Matsumoto and Nishida still do not explicitly disclose the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane which also contains a projection of one of the two-dimensional contour polygons and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the projected silhouette contour. However, these features were exceedingly well known in the art. For example, Watanabe discloses a three-dimensional model refining process that includes the steps of projecting each face of an initial three-dimensional model of an object onto a two-dimensional plane which also contains a projection of one of a two-dimensional contour and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the projected silhouette contour (page 4, paragraphs 43, 53 and page 5, paragraph 58).

Matsumoto, Nishida, and Watanabe are combinable because they are all concerned with image processing methods for modeling an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the refining process of Matsumoto

and Nishida so that it includes the steps taught by Watanabe. The suggestion/motivation for doing so would have been to enhance the precision of the three-dimensional model (Watanabe page 1, paragraphs 7-10). Therefore, it would have been obvious to combine Matsumoto and Nishida with Watanabe to obtain the invention as specified in claim 9.

Referring to claim 10, Matsumoto discloses a method for constructing a 3D model of an object from a series of photographic images of the object, where the series of photographic images have been captured from a plurality of different angles, where the angle associated image is determined from a pre-selected reference point in three-dimensional space and where the image is comprised of a plurality of pixels (col. 15, lines 25-67, col. 16, line 65-col. 17, line 3 and figures 1 and 6), the method comprising the steps of:

a. processing each photographic image to identify those clusters of pixels in the image that describe the object (col. 17, lines 2-27 and figure 6);

b. tracing the perimeter of each cluster of the pixels in the image that describe the object to gather a set of pixels which describe a silhouette contour of the object's shape, and thereby create a set of silhouette contours (col. 17, lines 2-27 and figure 6).

Matsumoto does not explicitly disclose the step of processing the points of the silhouette contours to select from those points the vertices of a polygon which approximates the silhouette contour of the object's shape, and thereby create a set of silhouette contour polygons. However, this feature was exceedingly well known in the art. For example, Nishida discloses the step of processing points of a silhouette contour to select from those points the vertices of a polygon which approximates the silhouette contour of an object's shape (col. 18, lines 19-41 and figures 8-10).

Matsumoto and Nishida are combinable because they are both concerned with image processing methods for determining a contour image of an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the silhouette contours of Matsumoto so that a polygon which approximates the silhouette contour of the object's shape is created, as taught by Nishida. The suggestion/motivation for doing so would have been to provide a compact expression of the structural features of the contour of the object, thereby enhancing the efficiency of the image processing method. Therefore, it would have been obvious to combine Matsumoto with Nishida.

Matsumoto further discloses the step of creating an initial three-dimensional model of the object using one of the silhouette contours, the three-dimensional model being formed by making a conical projection from one of the set of silhouette contours, creating along the bounds of the conical projection a near and far face for the object model, with the near and far faces each representing a projection of the vertices of the silhouette contour in three-dimensional space (col. 17, line 29-col. 18, line 10 and figures 7-8).

Matsumoto does not explicitly disclose the step of creating additional faces to span volume between the points of the near and far faces based on pairs of adjacent vertices in the near and far faces. However, Official notice is taken that the step of creating additional faces to span volume between the points of two faces based on pairs of adjacent vertices in the two faces was exceedingly well known in the art. Therefore, it would have been obvious to modify the method of Matsumoto and Nishida so that additional faces are created to span volume between the points of the near and far faces based on pairs of adjacent vertices in the near and far faces.

The suggestion/motivation for doing so would have been to enhance the appearance of the initial three-dimensional model.

Matsumoto further discloses the step of refining the initial three-dimensional model (col. 18, lines 3-47 and figure 9), but does not explicitly disclose that the refining process includes the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane of image collection for given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour polygons for the given image. However, the claimed refining process is not considered to be patently distinct from Matsumoto's refining process because both refining processes appear to be functionally equivalent. For example, Matsumoto explains that the initial three-dimensional model is refined by a (second) projection of a selected silhouette onto the initial model, wherein any portions of model that do not intersect the volume formed by the second projection are removed (col. 18, lines 10-26 and figure 9). Note that the steps described above in Matsumoto's refining process are functionally equivalent to the steps of projecting the initial three-dimensional model onto the two-dimensional plane for the selected silhouette, and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour for the given image--both refining processes result in the removal of any portions of the initial three-dimensional model that do not intersect the volume formed by the second projection of the selected silhouette onto the model. The applicant's specification provides further evidence of the functional equivalence described above. For example, on page 62, the applicants state:

> "To refine the initial, (rough) 317 model depicted at 690 based on the second silhouette contour polygon 694, the system and method of the present invention uses a procedure (described in further detail below) that in effect projects the initial (rough) 3D model depicted at 690 through a conical projection of the second silhouette 694. The system then adjusts the initial, (rough) 317 model depicted at 690, clipping from the model those areas that do not intersect the volume formed by the second projection."

Matsumoto clearly discloses these steps for his refining process (col. 18, lines 3-47 and figure 9). Accordingly, it appears that the results of Matsumoto's refining process are equivalent to the results of the claimed refining process, and therefore, the two refining processes are not considered patently distinct.

Despite the functional equivalence between the two refining processes, the Examiner notes that Matsumoto and Nishida still do not explicitly disclose the steps of projecting each face of the initial three-dimensional model of the object onto the two-dimensional plane of image collection for a given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour polygons for the given image. However, these features were exceedingly well known in the art. For example, Watanabe discloses a three-dimensional model refining process that includes the steps of projecting each face of an initial three-dimensional model of an object onto a two-dimensional plane of image collection for a given image and revising the set of vertices of the projected face so that it bounds the space which falls within the boundaries of the silhouette contour for the given image (page 4, paragraphs 43, 53 and page 5, paragraph 58).

Matsumoto, Nishida, and Watanabe are combinable because they are all concerned with image processing methods for modeling an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the refining process of Matsumoto and Nishida so that it includes the steps taught by Watanabe. The suggestion/motivation for doing so would have been to enhance the precision of the three-dimensional model (Watanabe page 1, paragraphs 7-10). Therefore, it would have been obvious to combine Matsumoto and Nishida with Watanabe to obtain the invention as specified in claim 10.

Referring to claim 17, see the rejection of at least claim 1 above. Matsumoto further discloses a system (130) that includes modules for performing the steps described above (col. 15, lines 25-59 and figures 3-4).

Referring to claim 18, see the rejection of at least claim 2 above. Matsumoto further discloses a computer-based system (130) that includes modules for performing the steps described above (col. 15, lines 25-59 and figures 3-4).

Referring to claim 19, see the rejection of at least claim 3 above. Matsumoto further discloses a system (130) that includes modules for performing the steps described above (col. 15, lines 25-59 and figures 3-4).

Referring to claim 20, see the rejection of at least claim 4 above. Matsumoto further discloses a computer-based system (130) that includes modules for performing the steps described above (col. 15, lines 25-59 and figures 3-4).

Referring to claim 25, see the rejection of at least claim 9 above. Matsumoto further discloses a computer-based system (130) that includes modules for performing the steps described above (col. 15, lines 25-59 and figures 3-4).

Referring to claim 26, see the rejection of at least claim 10 above. Matsumoto further discloses a system (130) that includes modules for performing the steps described above (col. 15, lines 25-59 and figures 3-4).

5. Claims 16 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Matsumoto et al., U.S. Patent No. 6,356,272 ("Matsumoto"), Nishida, U.S. Patent No. 6,424,746 ("Nishida").

Referring to claim 16 as best understood, Matsumoto discloses a method for constructing a 3D model of an object from a series of photographic images of the object, where the series of photographic images have been captured from a plurality of different angles, where the angle associated image is determined from a pre-selected reference point in three-dimensional space and where the image is comprised of a plurality of pixels (col. 15, lines 25-67, col. 16, line 65-col. 17, line 3 and figures 1 and 6), the method comprising the steps of:

a. generating a first plurality of images (B1-Bn) of the object (col. 16, line 65-col. 17, line 13);

b. generating a second plurality of images (A1-An) under lighting conditions in which the image is front lit (col. 16, line 65-col. 17, line 13); and

c. processing the first plurality of images to locate within each image a set of contours of the object (col. 17, lines 4-27).

Matsumoto does not explicitly disclose the step of locating a set of vertices which describe the contours of the object. However, this feature was exceedingly well known in the

art. For example, Nishida discloses the step of locating a set of vertices (polygons) which describe a contour of an object (col. 18, lines 19-41 and figures 8-10).

Matsumoto and Nishida are combinable because they are both concerned with image processing methods for determining a contour image of an object. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to modify the contours of Matsumoto so that a set of vertices which describe the contours of the object are obtained, as taught by Nishida. The suggestion/motivation for doing so would have been to provide a compact expression of the structural features of the contour of the object, thereby enhancing the efficiency of the image processing method. Therefore, it would have been obvious to combine Matsumoto with Nishida.

Matsumoto further discloses the step of creating an initial three-dimensional model of the object using the contours (col. 17, line 29-col. 18, line 10 and figures 7-8). In view of the combination described above, Matsumoto and Nishida disclose an initial three-dimensional model of the object that is based on the contour polygons. Accordingly, the initial three-dimensional model of the object comprises a plurality of polygonal faces.

Matsumoto further discloses the steps of:

d. processing each face of the polygon to locate each of the second plurality of images that portion of the image which corresponds to the face of the model (col. 19, line 19-col. 22, line 6);

e. determining a value for the area of that portion of each image which corresponds to the face of the model (col. 19, line 19-col. 22, line 6); and

f. associating with the face the one image from the second plurality of images which has the largest area value (col. 19, line 19-col. 22, line 6).

Matsumoto and Nishida do not explicitly disclose that the first plurality of images are captured under lighting conditions in which the image is backlit such that the background is lit and the object is not light. However, Matsumoto explains that the first plurality of silhouette images (B1-Bn) are obtained by a difference processing between the object images (A1-An) and a background image (col. 17, lines 2-27). The Examiner notes that although Matsumoto does not explicitly disclose the use two passes to capture the first and second plurality of images (each pass having its corresponding lighting conditions), this feature would have been obvious in Matsumoto because the "silhouette images" (B1-Bn) obtained from the difference processing are equivalent to the applicant's "first plurality of images", as claimed. For example, on pages 15-16 of the applicant's specification, it states "During the silhouette image capturing process of the present invention (which is described in further detail below), the background light devices 22 illuminate the background screen 16...causing it to glow and produce an illuminated background in each picture taken by the camera".

Applicants explain that the main advantage of utilizing two passes (and generating the first plurality of images under separate lighting conditions) is because it "eliminates the need to use colored backgrounds, such as green backgrounds, during image capture" (page 7). In this case, Matsumoto explains that his first plurality of images obtained by the difference processing can "eliminate the need of a special shooting environment to obtain a background image of a single color, and to allow stable silhouette image generation" (col. 17, lines 2-13). Therefore, it would have been obvious to modify Matsumoto's first plurality of images so that they are

captured under lighting conditions in which the image is backlit such that the background is lit and the object is not; since no new or unexpected results are seen to be attained by generating the first plurality of images under those lighting conditions as opposed to the difference processing.

Referring to claim 32, see the rejection of at least claim 16 above. Matsumoto further discloses a computer-based system (130) that includes modules for performing the steps described above (col. 15, lines 25-59 and figures 3-4).

Allowable Subject Matter

6. Claims 8 and 24 are allowed.

7. Claims 5-6, 21-22 would be allowable if rewritten or amended to overcome the claim objections set forth in this Office action.

8. Claims 7, 23 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Charles Kim whose telephone number is 703-306-4038. The examiner can normally be reached on Mon thru Thurs 8:30am to 6pm and alternating Fri 9:30am to 6pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au can be reached on 703-308-6604. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ck
January 24, 2005

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